



MINISTRY OF THE ENVIRONMENT
Water Resources Branch

NORTHERN ONTARIO WATER RESOURCES STUDIES

WATER RESOURCES REPORT 11a
MAP 1

GENERAL CHARACTERISTICS OF STREAMFLOWS

Scale 1:2,000,000
1 inch equals approximately 22 miles

Lambert Conformal Conic Projection
Standard Parallels 49°N and 54°N

LEGEND

- ▲ Streamflow station, continuous record, measuring regulated flow
- ▲ Streamflow station, continuous record, measuring natural flow
- ★ Meteorological station
- ★ Dam location
- (R) regulated (N) natural

DESCRIPTIVE NOTES

Illustrations by V.L. Olin
Cartography by B. Fisher

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The Northern Ontario Water Resources Studies

During the period from 1965 to 1972, the governments of Canada and Ontario undertook a series of coordinated studies of Ontario's northern water resources and related economic development. The work was undertaken in two major river basins that drain into James Bay and Lake Huron to the southwest. These are the Severn, the Winisk, the Attawapiskat, the Albany, and the Muskeg River basins. The overall objectives of the studies were to assess the quantity and quality of the water for all purposes, to determine the potential for development of the water resources, and to provide the information for the development of such water resources or elsewhere through diversions. The Government of Ontario designated as part of this programme and engineering capacity of the studies to the Ontario Water Resources Commission (OWRC) which is now part of the Ministry of the Environment (MOE). The OWRC assigned the Hydrology, Data and the Flow Data Systems Projects to members of the Division of Water Resources to produce these studies. Data on streamflow, ground water levels, snowfall, water chemistry, water biology, and hydrogeology that were collected by the MOE have been previously published in Water Resources Bulletin 1 through 10. This report on surface water quality is one of three data systems reports scheduled to be published by the MOE; the other two reports will cover the surface water quality and the ground water resources of the region.

Purpose and Scope of Report

The purpose of this report is to provide flow-duration and low-flow frequency analyses for flow records and streamflow characteristics for the northern part of Ontario. The information and frequency of occurrence of low flows, considered vital to the planning, management and protection of the Province's water resources, are presented. This report consists of two maps. Map 1 discusses the time and frequency distributions of streamflow and provides the general hydrology setting for streamflow characteristics in northern Ontario. Map 2 provides specific data on flow durations and low flows for those locations that are recommended with automatic streamflow recorders and for which several years of continuous daily records are available.

General Notes

The northern Ontario study area covers approximately 232,000 square miles. The density of streamflow gauging stations in this area is about one in four thousand square miles. In the northernmost part of the study area, the Severn, Winisk, and Attawapiskat River basins, continuous daily streamflow data are available since 1966, with the majority of the records starting from 1968. Streamflow data for stations in this area are for natural flow conditions. In the southeastern part of the study area, the Albany and Muskeg River basins, continuous daily streamflow data for many years or more are generally available for many stations. Flow in the two basins are for both natural and regulated conditions, with the majority of the records for natural flow conditions. Flow duration curves have been used as the basis for describing the general flow characteristics of streams and rivers. These curves were chosen because they are the most reliable effect on streamflow characteristics, hydrography, and geology. A comprehensive discussion of the applications and hydrologic significance of the flow duration curves is given by Heston (1965). A current period from 1968 to 1974 was chosen for streamflow analysis. As a result of these analyses, streamflow data are indicated by four types of flow-duration curves and regulated flow are indicated by three types. Representative only and monthly hydrographs are used to further illustrate the differences between types. Some precipitation data have been recorded as background information.

Summary and Conclusions

The main factors having the greatest influence on streamflows in the northern Ontario study area are: the time and spatial distribution of precipitation; the temperature and freeze-thaw characteristics of rivers and lakes; the degree of lake storage within a river system; and the degree of streamflow regulation within a river system. Mean annual precipitation and mean annual runoff are lowest in northwestern regions and highest in the southeastern regions. Mean monthly precipitation during the summer is generally greater than during the winter. Monthly runoff, as a percentage of annual runoff, is greatest during the months of May and June and least in March and April. Daily peak flows in the summer and fall, especially in the northern part of the study area, are often as great as, or greater than spring peaks. Annual maximum flows, averaged over 7-day intervals, occur most frequently during the months of March and April. Lake storage within natural river systems has the most notable effect on streamflow characteristics. This is especially evident in the Severn River basin where the range of mean daily discharges are small and where the flows are sustained. Within regulated flow systems, regulatory policy is of major importance to the low-flow conditions of the river. Low flows are regulated at dam stations, sometimes zero at others, and very often zero over long periods downstream of the diversions.

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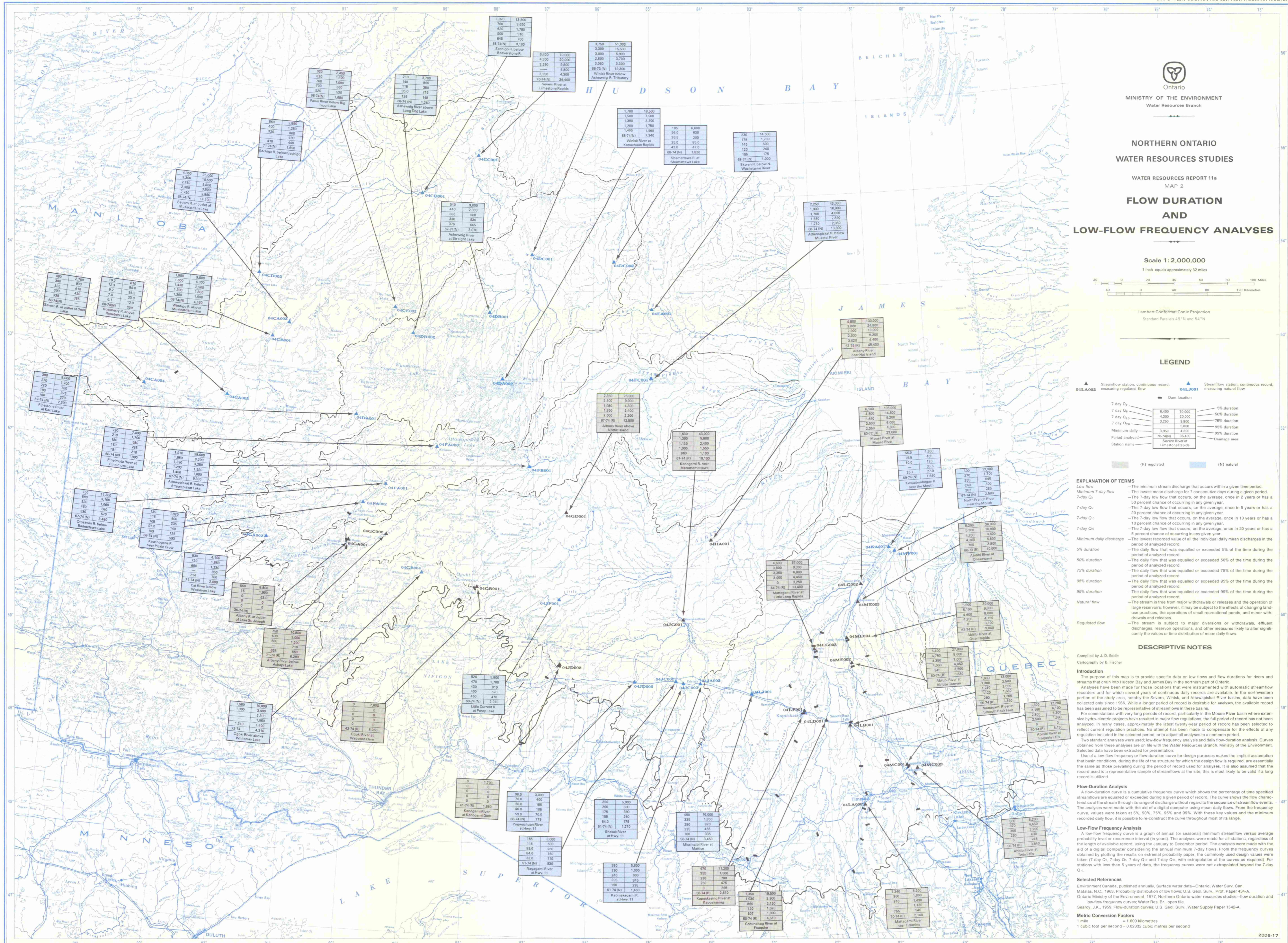
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- 2243, Data for northern Ontario water resources studies, 2508-2509. Water Res. B.
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- 2263, Data for northern Ontario water resources studies, 2548-2549. Water Res. B.
- 2264, Data for northern Ontario water resources studies, 2550-2551. Water Res. B.
- 2265, Data for northern Ontario water resources studies, 2552-2553. Water Res. B.
- 2266, Data for northern Ontario water resources studies, 2554-2555. Water Res. B.
- 2267, Data for northern Ontario water resources studies, 2556-2557.

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NORTHERN ONTARIO WATER RESOURCES STUDIES

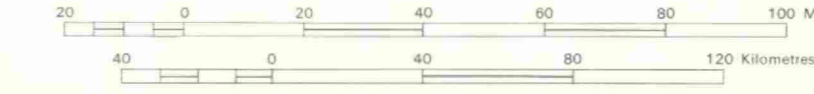
WATER RESOURCES REPORT 11a

MAP 2

FLOW DURATION AND LOW-FLOW FREQUENCY ANALYSES

Scale 1:2,000,000

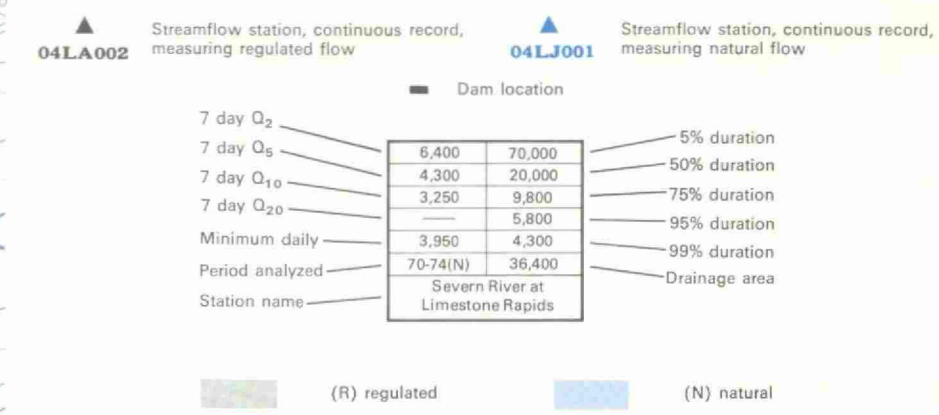
1 inch equals approximately 32 miles



Lambert Conformal Conic Projection

Standard Parallels 49°N and 54°N

LEGEND



EXPLANATION OF TERMS

Low flow—The minimum stream discharge that occurs within a given time period.
Minimum 7-day flow—The lowest mean discharge for 7 consecutive days during a given period.
7-day Q₂—The 7-day low flow that occurs, on the average, once in 2 years or has a 50 percent chance of occurring in any given year.
7-day Q₅—The 7-day low flow that occurs, on the average, once in 5 years or has a 20 percent chance of occurring in any given year.
7-day Q₁₀—The 7-day low flow that occurs, on the average, once in 10 years or has a 10 percent chance of occurring in any given year.
7-day Q₂₅—The 7-day low flow that occurs, on the average, once in 20 years or has a 5 percent chance of occurring in any given year.
7-day Q₅₀—The lowest recorded value of all the individual daily mean discharges in the period of analyzed record.
5% duration—The daily flow that was equalled or exceeded 5% of the time during the period of analyzed record.
50% duration—The daily flow that was equalled or exceeded 50% of the time during the period of analyzed record.
75% duration—The daily flow that was equalled or exceeded 75% of the time during the period of analyzed record.
95% duration—The daily flow that was equalled or exceeded 95% of the time during the period of analyzed record.
99% duration—The daily flow that was equalled or exceeded 99% of the time during the period of analyzed record.
Natural flow—The stream is free from major withdrawals or releases and the operation of large reservoirs; however, it may be subject to the effects of changing land-use practices, the operations of small recreational ponds, and minor withdrawals and releases.
Regulated flow—The stream is subject to major diversions or withdrawals, effluent discharges, reservoir operations, and other measures likely to alter significantly the values or time distribution of mean daily flows.

DESCRIPTIVE NOTES

Compiled by J. D. Eddie
 Cartography by B. Fischer

Introduction
 The purpose of this map is to provide specific data on low flows and flow durations for rivers and streams that drain into Hudson Bay and James Bay in the northern part of Ontario. Analyses have been made for those locations that were instrumented with automatic streamflow recorders and for which several years of continuous daily records are available. In the northwestern portion of the study area, notably the Severn, Winisk, and Attawapiskat River basins, data have been collected only since 1966. While a longer period of record is desirable for analyses, the available record has been assumed to be representative of streamflows in these basins.
 For some stations with very long periods of record, particularly in the Moose River basin where extensive hydro-electric projects have resulted in major flow regulations, the full period of record has not been analyzed. In many cases, approximately the latest twenty-year period of record has been selected to reflect current regulation practices. No attempt has been made to compensate for the effects of any regulation included in the selected period, or to adjust all analyses to a common period.
 Use of a low-flow frequency or flow-duration curve for design purposes makes the implicit assumption that basin conditions, during the life of the structure for which the design flow is required, are essentially the same as those prevailing during the period of record used for analyses. It is also assumed that the record used is a representative sample of streamflows at the site; this is most likely to be valid if a long record is utilized.

Flow-Duration Analysis

A flow-duration curve is a cumulative frequency curve which shows the percentage of time specified streamflows are equalled or exceeded during a given period of record. The curve shows the flow characteristics of the stream through its range of discharge without regard to the sequence of streamflow events. The analyses were made with the aid of a digital computer using mean daily flows. From the frequency curves, values were taken at 5%, 50%, 75%, 95%, and 99%. With these key values and the minimum recorded daily flow, it is possible to re-construct the curve throughout most of its range.

Low-Flow Frequency Analysis

A low-flow frequency curve is a graph of annual (or seasonal) minimum streamflow versus average probability level or recurrence interval (in years). The analyses were made for all stations, regardless of the length of available record, using the January to December period. The analyses were made with the aid of a digital computer considering the annual minimum during the period of record. From the frequency curves, values were taken at 5%, 50%, 75%, 95%, and 99%. With these key values and the minimum recorded daily flow, it is possible to re-construct the curve throughout most of its range.

Selected References

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Metric Conversion Factors

1 mile = 1.609 kilometres
 1 cubic foot per second = 0.02832 cubic metres per second